mounting said second bearing with said second sleeve disposed thereon, on said spindle disposed in said housing opening so that said second bearing is received in said second enlarged section, the outer race of said second bearing is seated on said annular surface of said second enlarged section and said second sleeve is disposed adjacent the annular side wall of said second enlarged section, with said adhesive bonding material disposed therebetween; and

allowing said adhesive bonding materials to set to rigidly secure said sleeves to said housing, permitting said spindle to displace along an axial line of travel relative to said housing.

Remarks

Applicant acknowledges with appreciation the grant of an extended period of time in which to respond to the outstanding communication.

Claims 1, 6, 11 and 12 have been amended to recite, "at least one bearing seat" in lieu of simply "bearing seat." Claim 1 further has been amended to recite the spindle being axially aligned relative to the bearing, and the spindle and bearing being displaceable axially relative to the sleeve. Claim 15 has been amended to recite mounting the spindle with the first bearing and the first sleeve on the housing so that the first sleeve is disposed adjacent to the first bearing seat with the adhesive bonding material therebetween, and mounting the second bearing with the second sleeve thereon on the spindle and the second bearing seat with the adhesive bonding material therebetween. Claim 16 has been amended in line 27 to recite, "a second bearing" in lieu of "said second bearing." Such amendments are deemed to overcome the Examiner's rejection on the grounds of indefiniteness as set forth in paragraph 4 of the communication.

With regard to the Examiner's rejection on the grounds of there being no recitation of an axis for determining what is meant by the terms "axial" or "axially," it is submitted that in the art to which the present invention pertains, a person having ordinary skill would understand and

recognize that a spindle has an axis and that any reference to the terms "axial" and "axially" would relate to the axis of such a spindle. Further with respect to claim 16, Applicant fails to understand the Examiner's assertion to the effect that there is no frame of reference provided for determining what is meant by "outwardly facing." It would appear to be clear that an outwardly facing surface would be a surface facing the exterior of the housing. Perhaps the Examiner can further enlighten Applicant as to the indefiniteness of such term so that Applicant can more effectively respond to such grounds of rejection.

It is noted that all of the claims in the application further have been rejected as being obvious in view of U.S. Patent 1,761,841 to Nenninger. In this regard, it is understood that the Examiner has asserted that it would be obvious to a person having ordinary skill in the art to provide an epoxy resin adhesive in lieu of a stud screw 72 to secure the component designated by the reference numeral 70 to the housing in Nenninger and thus arrive at the structure recited in claims under rejection. In response to such grounds of rejection, Applicant submits that the rationale for such rejection completely disregards the objectives of the present invention and misconstrues the teachings or suggestions of the secondary reference cited.

Because of the speeds at which the spindles of the present invention are run, i.e., up to 20,000 rpm, the bearing seats, the bearings mounted on the bearing seats and the spindle mounted in the bearings must be accurately, axially aligned. Otherwise, laterally directed loads produced by the high speed rotation of the spindle will create an axis of inertia that is not parallel to the axis of rotation and thus will result in undo wear of the bearing seats, the bearing roller balls, the spindle or combinations of such components, and malfunction or premature failure of the spindle assembly. In order to obtain the required concentricity with respect to the bearing seats, bearings and spindle of such assemblies, it is required that the annular surfaces of the

bearing seats not only be machined to close tolerances but that such surfaces be ground following machining. Such close tolerance machining and grinding is very costly and is an operation which the present invention seeks to eliminate. By providing sleeves on the bearings and then adhesively securing the sleeves to the annular surfaces of the bearing seats, the bearings and spindle not only maintain concentricity but allow the bearings to displace axially relative to the spindle. Because the adhesive does not apply any force at any localized area as a threaded member as in the Nenninger structure, its use will not disturb the concentricity of the spindle assembly.

With regard to the actual construction of the assembly disclosed in the Nenninger patent, it is to be noted that there is no sleeve provided, disposed between a bearing race and a bearing seat, in which the sleeve is secured by any means to a surface of a bearing seat. Instead, Nenninger discloses a member disposed in a housing opening, providing a bearing seat, a bearing mounted in such bearing seat and a spindle journaled in such bearing. The component of the Nenninger assembly identified by the reference numeral 70 and designated as a sleeve is in fact a component providing a bearing seat. Nenninger does not provide any sleeve between a bearing seat and a bearing. It provides merely a component providing a bearing seat between a bearing and a housing and a stud screw for securing such bearing seat component to the housing.

It further is submitted that Nenninger does not disclose or teach any method for assembling the assembly disclosed therein as a recited in Applicant's method claims. There is no disclosure of assembling the components in the sequence recited in Applicant's claims or applying an adhesive for securing the sleeves to the bearing seats as recited in Applicant's claims.

The secondary reference relating to adhesives simply indicates that adhesives may be used to achieve metal-to-metal bonding. It does not teach or suggest the use of an adhesive to secure a sleeve containing a bearing to a bearing seat as provided for in Applicant's claims.

In view of the foregoing, it respectfully is requested that the rejection of Applicant's remaining claims be withdrawn and that the application be passed to issue.

Respectfully submitted,

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Appendix

Claims 1, 6, 11, 12, 15 and 16 have been amended as follows:

1. (Twice amended) A spindle assembly for a machine tool comprising:

a housing having at least one bearing seat;

a bearing having an inner race and an outer race disposed in said at least one bearing seat;

a sleeve disposed between one of the inner and outer races of said bearing and said housing, bonded to said housing; [and]

a spindle mounted on another one of the inner and outer races wherein said spindle is axially aligned relative to said bearing and said spindle and bearing are displaceable axially relative to said sleeve; and

wherein said sleeve is bonded to said housing with a metal-to-metal adhesive bonding material.

6. (Twice amended) A spindle assembly according to Claim 1 [when] wherein said housing is provided with an opening having an enlarged section defining said at least one bearing seat, the outer race of said bearing is disposed in said at least one bearing seat, said sleeve is disposed between said outer race of said bearing and said at least one bearing seat and is bonded to said housing and said spindle is received within said opening and journaled in the inner race of said bearing.

11. (Twice amended) A method of fabricating a spindle assembly for a machine tool comprising:

forming at least one bearing seat in a housing;

mounting a spindle on one of an inner race and an outer race of a bearing;

mounting a sleeve on the other of said races of said bearing so that said bearing is

displaceable axially relative to said sleeve;

applying an adhesive bonding material to at least one of a surface of said sleeve and a surface of said at least one bearing seat;

mounting said spindle with said bearing and sleeve, on said housing so that said surface of said sleeve is disposed adjacent to said surface of said at least one bearing seat with said adhesive bonding material adjoining said surfaces; and

allowing said bonding material to set to rigidly secure said sleeve to said housing, permitting said bearing to displace along an axial line of travel relative to said sleeve.

12. (amended) A method according to Claim 11 including forming said at least one bearing seat slightly oversized relative to said sleeve.

15. (Twice amended) A method according to Claim 11 including:

forming first and second bearing seats in said housing;

mounting said spindle on one of an inner race and an outer race of a first bearing;

mounting a first sleeve on another one of said inner and outer races of said first bearing so that said first bearing is axially displaceable relative to said first sleeve;

applying an adhesive bonding material to at least one surface of said first sleeve and a surface of said first bearing seat;

mounting said spindle with said first bearing and first sleeve, on said housing so that said first sleeve [surface] is disposed adjacent said first bearing seat [surface] with said adhesive bonding material [adjoining said surfaces] therebetween;

mounting a second sleeve on [a] one of an inner and outer race of a second bearing so that said second bearing is axially displaceable relative to said second sleeve;

applying an adhesive bonding material on at least one of a surface of said second sleeve and a surface of said second bearing seat;

[mounting another race of said second bearing on said [house] housing so that said [second sleeve] surface of said second sleeve and said second bearing seat is disposed adjacent said second bearing seat surface with said adhesive bonding material adjoining said second sleeve surface and said second bearing seat surface;]

mounting another one of said inner and outer races of said second bearing on said spindle and said second bearing with said second sleeve in said second bearing seat with said adhesive bonding material between said second sleeve and said second bearing seat; and

allowing said adhesive bonding materials to set to rigidly secure said sleeves to said housing, permitting said bearings to displace along an axial line of travel relative to said spindle, relative to said sleeve.

16. (Twice amended) A method of fabricating a spindle assembly for a machine tool comprising:

providing a housing having an [axial] opening therethrough with spaced, first and second enlarged sections providing outwardly facing annular seating surfaces and annular side walls;

mounting a first annular sleeve on an outer race of a first bearing so that said first bearing is axially displaceable relative to said first sleeve;

mounting said first bearing with said first sleeve disposed thereon onto a spindle having an annular seating surface so that an inner race of said first bearing seats on said annular seating surface of said spindle;

applying an adhesive bonding material to at least one of a surface of said first sleeve and the annular side wall of said first enlarged section of said housing opening;

inserting said spindle with said first bearing and first sleeve disposed thereon into said housing opening so that said first bearing is received in said first enlarged section, the outer race of said first bearing is seated on said annular surface of said first enlarged section and said annular sleeve is disposed adjacent the annular side wall of said first enlarged section with said adhesive bonding material disposed therebetween;

mounting a second annular sleeve on an outer race of [said] a second bearing so that said second bearing is axially displaceable relative to said second sleeve;

applying an adhesive bonding material to at least one of a surface of said second sleeve and the annular side wall of said second enlarged section of said housing opening;

mounting said second bearing with said second sleeve disposed thereon, on said spindle disposed in said housing opening so that said second bearing is received in said second enlarged section, the outer race of said second bearing is seated on said annular surface of said second enlarged section and said second sleeve is disposed adjacent the annular side wall of said second enlarged section, with said adhesive bonding material disposed therebetween; and

allowing said adhesive bonding materials to set to rigidly secure said sleeves to said housing, permitting said spindle to displace along an axial line of travel relative to said housing.